

Mechanical Engineering News

COADE, Inc.

For the Power, Petrochemical and Related Industries

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The COADE Mechanical Engineering News Bulletin is intended to provide information about software applications and development for Mechanical Engineers serving the power, petrochemical, and related industries. The Bulletin also serves as the official notification vehicle for software errors discovered in those programs offered by COADE.

Note that COADE's Phone, Fax, and BBS Numbers Effective *November 2, 1996*, will be:

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Fax: (281) 890-3301
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Highlights:

Graphics in **CodeCalc**!

TANK Upgrade Offered!

Stoomwezen Approves **CAESAR II**!

PVELite Enhancements Continue!

CADWorx/Pipe Now In Windows NT/95!

COADE Joins World Wide Web!

Seminars Overflowing -- Book Early!

COADE Adds Two Dealers in Asia!

...And see back page for a summary of why running the latest COADE Software is important!

COADE WEB Page Debuts

By Richard Ay

On September 1, 1996, COADE's World Wide Web site officially came on line. A WEB site is a collection of hypertext documents linked together, sometimes associated



with data files, residing on the Internet. This WEB site provides a variety of capabilities to viewers, from access to information on COADE's software to downloading demos and software patches. Using the COADE WEB site, users can stay up to date with COADE news and development status in order to maintain an informed posture.

Our WEB site address is <http://www.coade.com>. We also have a new E-Mail address, which is query@coade.com. The old E-Mail address of coade@hti.net should not be used any longer.

The *Home Page* of the WEB site is shown on the previous page. The icons at the top of the page remain in the viewing window throughout the session. At the bottom of the *Home Page* (if you are using NetScape), is the *marque* area. In this area the latest important news can be displayed for immediate review.

The icons enable rapid navigation of the WEB Site. (Documents and files on the WEB Site are arranged logically in a directory structure. Users can traverse up and down this directory structure, viewing documents and following links.) The use of icons allows a direct jump to any point in the directory structure, without traversing up and down.

For users utilizing a WEB browser that does not support icons, the menu at the bottom of the page is available. The same documents can be reviewed and the same files acquired by using the menu structure instead of the icons, it just takes longer to find what you are looking for.

The icons and menu items have a one to one correspondence. These associations and their meaning are discussed in the paragraphs below.

Reference Book: Beginning with the far left icon, a reference book can be seen. This icon is associated with the menu item "General Information Files". This selection provides a menu listing a directory for each COADE software program. Within each of these directories, various documents on related topics can be reviewed.

News Paper: Moving right, the next icon is a news paper, which is associated with the menu item "COADE News". This selection displays the COADE news file, with important items appearing in reverse chronological order.

Programmer at Keyboard: Moving right, the next icon is a programmer pounding the keyboard to produce software products. This icon is associated with the menu item "COADE Product Information". This selection presents a menu on all COADE products and allows a review of the product descriptions.

Parchment & Quill: The next icon to the right is a registration icon. This icon is associated with the "Register with COADE" menu item. This selection presents the viewer with a registration form to request additional product information.

COADE, Inc: The next icon to the right is the COADE name. This icon is associated with the menu item "COADE Company Information". Selecting this item produces a document discussing the COADE organization.

Mail Slot: The next icon to the right is an envelope in a mail slot. This icon is not associated with a menu item. This selection produces an E-Mail form for submission to COADE.

Links: The next icon to the right is a series of chain links. This icon is associated with the menu item "Links to Related Sites". This selection produces a sub-menu on which other WEB sites are grouped by category; engineering sites, COADE dealers, and miscellaneous.

Down Arrow to Disk Drive: The next icon to the right represents a download procedure. This icon is associated with the menu item "File Downloads/Patches". This selection produces a sub-menu from which the files and patches for each software product can be acquired.

Hardware Lock: The next icon to the right is an image of an External Software Lock, ESL. This icon is associated with the menu option "ESL Update Form". This selection produces the remote ESL update form which can be submitted to COADE once completed.

The COADE WEB site is intended to keep users up to date with the latest developments at COADE, and the status of the current software. As noted in previous articles in *Mechanical Engineering News*, you should check the NEWS file on the BBS or WEB site at least once a month to insure you stay current on these issues.

CAESAR II Obtains Stoomwezen Approval

In April 1996, **CAESAR II** obtained approval from the Dutch certification authority, Stoomwezen. The approval process involved the input and analysis of a number of benchmark piping systems. The analytical accuracy as well as the program documentation were reviewed and verified by Stoomwezen and subsequently approved. Stoomwezen approval is required for software to be used on engineering projects in The Netherlands.

Stoomwezen is the only governmental organization, that we know of, which approves engineering software. To our knowledge, there are no U.S. agencies that approve engineering software.

COADE Announces Two New Dealers

As part of COADE's efforts to better serve our international customers, we are pleased to announce the addition of two new dealers of COADE products in East Asia.

Serving Southeast Asia (Singapore, Malaysia, Indonesia, Thailand, Vietnam, and Brunei) is Industrial & Offshore Computer Services Pte Ltd. (IOCS); the primary contact is Ms. Helene Loo. IOCS' address is:

P.O. Box 62
Singapore 139951
Tel: (65) 779 5122
Fax: (65) 778 9200

Serving the People's Republic of China and Hong Kong is IMVEC (China) Ltd.; the primary contact is Mr. Henry Pan. IMVEC is located at:

Room 908, Science & Technology Mansion
11 Baishiqiao Road
Haidian District, Beijing 100081
People's Republic of China
Tel: (86) 10 68467028
Fax: (86) 10 68467031

Both of these dealers sell, service, and support the full line of COADE products.

New in CAESAR II Version 3.24

By Richard Ay

Work on **CAESAR II** Version 3.24 is underway. This version of **CAESAR II** is scheduled to include:

- Multiple displacement, force, and uniform load cases
- User-modifiable material database
- Addition of the UKOOA (FRP) piping code
- Support of vendors' FRP material data
- Expanded valve and flange database

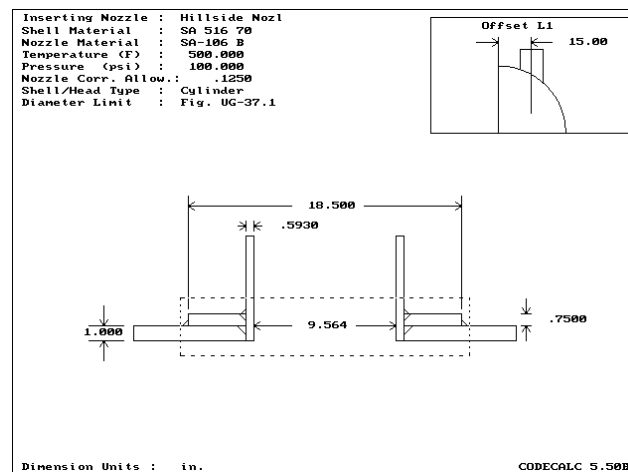
- ASCE 95 wind computations
- Support for eight character job names
- Revisions of some "defaults" in the Configuration/Setup module, plus password protection for computation controls
- Support for multiple users in the same network data directory
- Addition of Z662 Canadian Oil and Gas Codes (replacing Z183 and Z184)
- BS 5500 nozzle flexibilities
- Improved interfacing with CADWorx/Pipe

This will be the last DOS version of **CAESAR II**; work on the Windows 95 version is well underway. We anticipate the Windows version of **CAESAR II** will be available by the second quarter of 1997.

New in CODECALC Version 5.50

By Tom Ren

CodeCalc has long enjoyed a loyal following, for whom the program's only flaw was its lack of graphic output. In late June 1996, Version 5.50 of **CodeCalc** was released. This version of **CodeCalc** includes graphics capabilities for *every* module (17 independent components for pressure vessel and heat exchangers). A *scaled* and *dimensioned* plot will be drawn automatically based on the user's input – just by pressing **P** from any input spreadsheet. The on-screen plot can also be sent directly to the Printer (LaserJet or DotMatrix), or saved as a .PCX file which can be used in most standard word processing programs. The following is a typical Nozzle plot:



In version 5.50 of **CodeCalc**, the A-95 addendum of the ASME Section VIII Div 1 has been incorporated. A few important changes include:

- Appendix 1-7 for Large Nozzle reinforcement calculations
- UG-41 for Nozzle weld loads and strength paths calculations
- Appendix AA for ASME Tubesheet calculations
- Appendix CC for Expansion Joint life cycle calculations
- Also the material database has been updated according to the changes in ASME Sec II Part D, A-95

Additionally, **CodeCalc** 5.50 has numerous new additions/enhancements for calculations. A few examples are listed below:

- The WRC107 module is now able to accept input either in local or global coordinates and perform the stress summation and check the stresses per ASME Sec. VIII Div 2
- The Conical Section module can now perform discontinuity stress calculations at Cone-to-Cylinder junctures
- Flange module can calculate minimum gasket width. Also Gasket Seating MAWP can be readily calculated along with Operating MAWP
- Leg&Lug module now incorporates continuous top support rings (girder ring), etc.

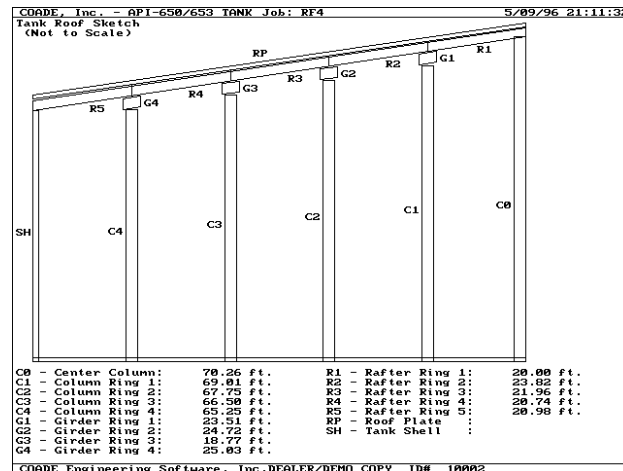
New in TANK Version 1.40

By Richard Ay

Version 1.40 of **TANK** released in September, incorporates the latest Code revisions, as well as a number of refinements. The major changes made for this version are:

- API-650 9th Edition, Addendum 2 changes have been incorporated. The most significant item here is the addition of rules to cover **stainless steel** tanks. See the related article in this issue of *Mechanical Engineering News* for details.
- API-653 2nd Edition changes have been incorporated. See the related article in this issue of *Mechanical Engineering News* for details.

- Additional graphics options have been incorporated. This will allow plotting of the supported cone roof design results. The figure below illustrates the results of one example roof design.



Due to the numerous improvements made in recent releases of **TANK**, COADE is giving all **TANK** users the chance to inexpensively upgrade to the latest version of the software. Upgrading will also enroll **TANK** users into the newly implemented **TANK Maintenance / Support Plan** for one year. This entitles registered users to a full year of new releases, technical support, and patches. For information on this upgrade offer please contact COADE or your dealer.

New in PVElite Version 2.00

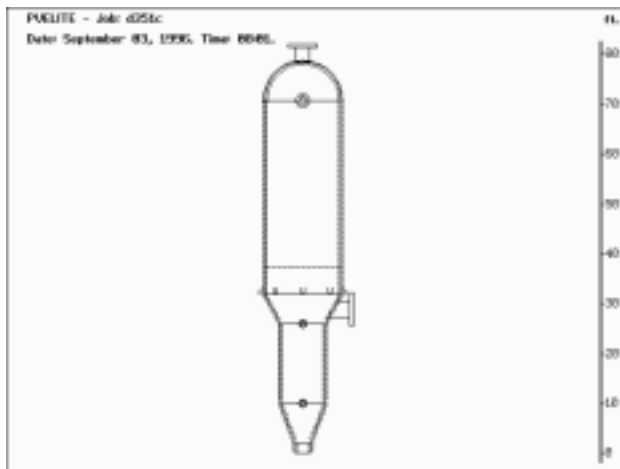
By Scott Mayeux

July 1996 marked the release of **PVElite** Version 2.0. **PVElite** is an ASME Section VIII Division 1 pressure vessel design program that analyzes/designs vertical or horizontal pressure vessels accounting for wind and seismic loads as well as user entered forces and moments. This release succeeded version 1.15 released earlier this year. In addition to being compliant with the 1995 winter addenda, version 2.0 adds new capability making this one of the most complete pressure vessel design programs available. Some of the new program features are:

- Analysis of Lifting Lugs
- Analysis of Thick Walled and Bellows Type Expansion Joints
- Analysis of Floating Heads
- Analysis of Tubesheets per ASME or TEMA

- Analysis of Large Centrally located openings per App. 14
- Local stress calculations per WRC107 and Stress Summation Per. Div. 2
- Analysis of Rectangular Vessels per App. 13
- Branch Reinforcement Calculations per B31.3
- Half Pipe Jacket Analysis per App. EE
- Wind design per ASCE, UBC, NBC, IS-875 or User Wind Profile
- Seismic design per ASCE, UBC, NBC, IS-1893 Response Spectra and SCM

In short, **PVElite** shares all of the component calculations available in **CODECALC** Version 5.50. Also in version 2.0 the flange and base-ring design is integral to the program's input. **PVElite** can also analyze vertical vessels on lug supports and intermediate skirts. A lug supported geometry is pictured below:



In a model such as this one, **PVElite** computes the forces and moments at each girth seam as well as the forces and moments around the lugs. This is a critical concern because an element below the lugs could be overstressed due to the combined stress effects of internal pressure, wind/seismic and weight.

New in CADWorx/PIPE Version 1.00b

By Robert Wheat

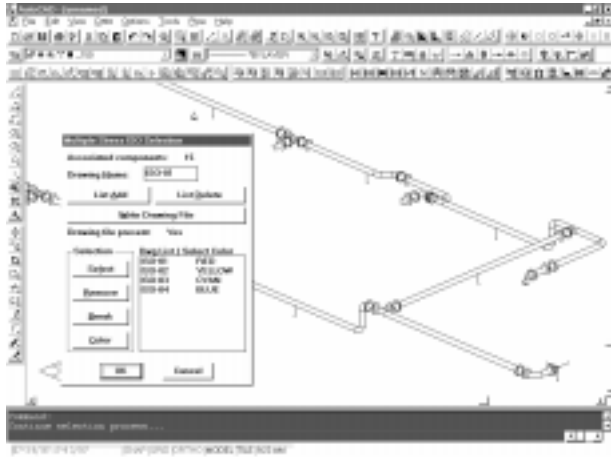
This update to **CADWorx/PIPE** now runs under AutoCAD Release13c4 for Windows 95/NT! (Note: The program still fully operates in Release 12 DOS/Windows and Release 12 DOS.) With the migration to this environment, **CADWorx/PIPE** includes 11 new toolbars that provide approximately 50 flyouts and 180 buttons. These toolbars vastly improve the performance over a digitizer. They are right on the screen in the proximity of your work area. There is no need to look away at the digitizer or need to re-orient yourself upon returning to the screen. This new environment will surely provide increased productivity for anyone who works in multiple applications. The performance in terms of speed, memory usage and general operability is also far superior than its Release 12 counterpart.

Other key features of the **CADWorx/PIPE** for Windows 95/NT:

- On-line help facility, Press F1 while the menu command is highlighted.
- File utilities are consistent across the entire platform (i.e., saving, opening, etc.).
- Instant access to many on screen toolbars and buttons.
- Performance and productivity is increased by running multiple applications at once.

One of the most significant additions to **CADWorx/PIPE** version 1.00b is the *Multi-ISO* facility for **CAESAR II** stress isometrics. Many users informed us that they had **CAESAR II** input files which were too large to be clearly drawn on a single sheet isometric. In response, we have developed a method of easily breaking this model into multiple sheets.

After importing a complete model, a dialog is displayed to allow detailed selection of components to be displayed on separate stress isometrics sheets. The dialog keeps track of the components selected and allows you to make multiple groups or sets. After selection of the different component sets, each individual isometric can be automatically completed. Annotation, pertinent to that individual isometric, can then be provided through the normal annotation dialog.



CADWorx/PIPE Model courtesy of Jacobs Engineering, Houston, Tx. This screen capture shows not only the Multi ISO selection but also the many toolbars available in the CADWorx/PIPE dialog.

Automatic dimensioning in isometrics and in general has been vastly improved. In addition to being significantly faster, auto dimensioning can be applied to any model.

The installation program has been improved to allow for easier program setup. For example, the new installation program automatically loads the appropriate drivers to optimize the performance of the hardware lock. Additionally,

both DOS and Windows for Release 12 and 13 all come on the same diskettes therefore avoiding confusion of which version you might be using.

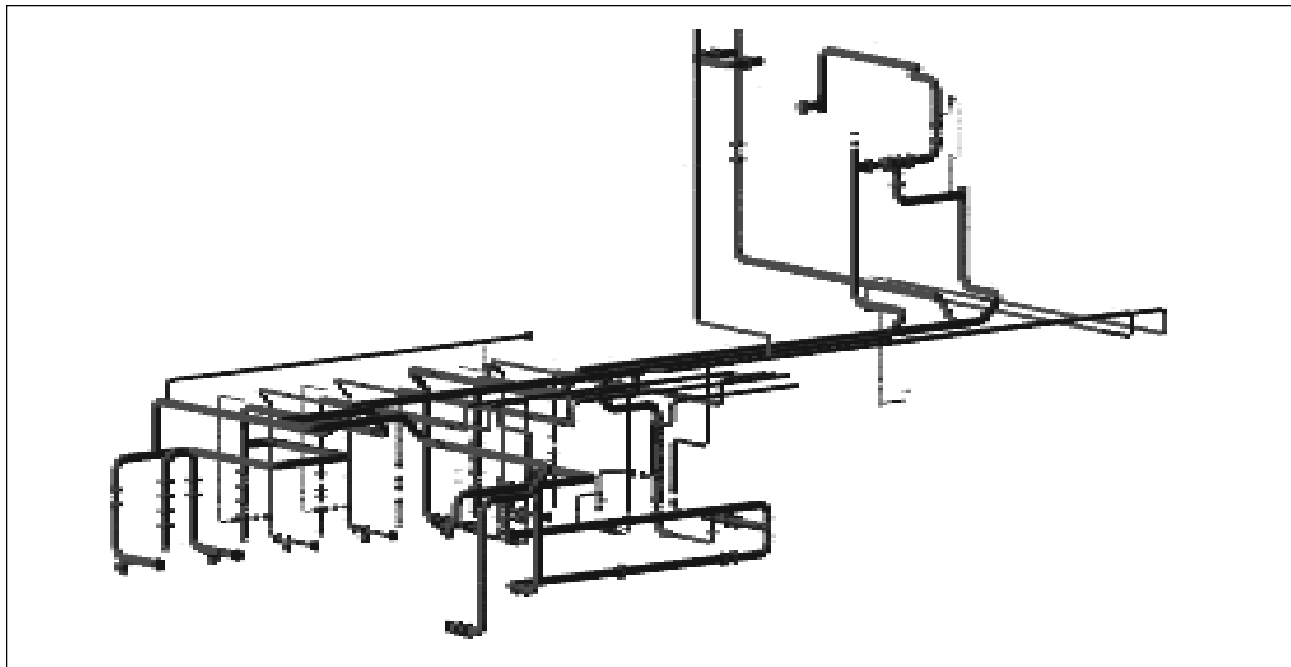
The **CAESAR II** bi-directional interface has also been improved, eliminating any problems encountered by users of the earlier versions of the software.

CADWorx/PIPE users say:

Rudy Rapp
 CADD Solutions
 Calgary, Canada
“Finally someone (COADE) has developed a piping program that is simple and easy to use.”

Dr. Marian Nicolescu
 Litwin Romania
 Ploiesti, Romania
“CAESAR II users have been waiting a while for a product which could help them to be more productive and to communicate better with the entire engineering team.”

Claudio Garavaglia
 (creator of 3D piping model below)
 Milano, Italy
“CADWorx/PIPE solves many of the problems in working with 3D models and has saved up to 90% of my time.”



Seminars at COADE

Periodically, COADE offers technical seminars to assist users in the application of software to their engineering problems. These seminars cover the basics of the piping and pressure vessel codes, as well as current industry practice and computer modeling. These seminars have been well received by industry, and as a result are always filled to capacity. In many instances, prospective seminar attendees must attend a later seminar, since the desired seminar is full. Users planning to attend a COADE seminar should arrange their schedules early, and register as soon as possible. The seminars typically fill up four to six weeks prior to the seminar date!

Increased demand has led to the addition of one **CAESAR II** seminar per year to the 1997-98 schedule. To assist in scheduling, the seminars planned for 1997 and 1998 in COADE's Houston office are listed below.

CAESAR II Pipe Stress Seminars

<u>1997</u>	<u>1998</u>
January 13-17	January 12-16
March 10-14	March 9-13
April 28 - May 2	April 27 - May 1
June 9-13	June 8-12
September 22-26	September 21-25
November 17-21	November 16-20

Pressure Vessel Seminars

<u>1997</u>	<u>1998</u>
February 5-7	February 11-13
October 15-17	October 14-16

CADWorx/Pipe Seminars

<u>1997</u>	<u>1998</u>
May 5-7	May 4-6
September 29-October 1	September 28-30

Seminars run from 8 am to 5 pm, with lunch catered in the seminar facility. Each attendee receives a set of course notes for future reference, as well as handouts of examples worked throughout the seminar. During the course of the seminar, attendees utilize the software to solve problems typically encountered in industry. Each attendee is provided with an individual computer for use during the seminar.

COADE Software Revision Procedures

By Richard Ay

This document describes the procedures whereby users can insure that they are using the latest revision to the current versions of COADE software products. Obtaining, installing, and archiving software patches are discussed in the following paragraphs.

COADE software products are not static, they are changed continually to reflect: engineering code addenda, operational enhancements, user requests, operating system modifications, and corrections. New versions are planned and targeted for a specific release date. However, there may be corrections necessary to the "currently shipping" version, before the next version can be released. When this occurs, a correction to the "currently shipping" version is made. This correction is referred to as a "patch".

A change made for a specific user is made available for that user immediately. The change is either sent directly on diskette, or made available on the COADE Bulletin Board System (BBS) or Internet WEB site.

Changes and corrections are accumulated until either: the disk space used by the changed files exceeds 800 Kbytes, or an error producing incorrect results is found. When either of these criteria are met, the patch is finalized, announced, and posted to the BBS and WEB sites.

How Are Patches Identified?

Patches are identified with single letters: A, B, C, etc. The first patch (to a specific version) is Patch A, the second is Patch B and so on. The patch files are distributed as self-extracting .ZIP archives (which means they have a .EXE suffix). Once on a users computer, the .EXE file can be run to extract and install the patched files. (Additional details on installing patches can be found below.)

Patch files have a naming convention, as follows. The first two characters of the file name represent the COADE program being patched; C2 for **CAESAR II**, CC for **CODECALC**, PV for **PVElite**, TK for **TANK**, and CW

for **CADWorx/PIPE**. The next three characters represent the version number, for example C2323 would indicate **CAESAR II** Version 3.23. The next character represents a specific patch, using letters starting with “A” and continuing as necessary. The next two characters are an “underscore” and a single letter representing the ESL version (the ESL is the External Software Lock used by the programs). The characters _U represent an unlimited or full run version, _L is an execution limited version, _D is a dealer version, and _X indicates a non-ESL specific patch. The following examples illustrate this naming convention.

<u>Patch Name</u>	<u>Correlation</u>
C2322D_U.EXE	CAESAR II , Version 3.22, Patch D, full run users
C2322E_X.EXE	CAESAR II , Version 3.22, Patch E, all users
C2322F_D.EXE	CAESAR II , Version 3.22, Patch F, dealers
TK131B_U.EXE	TANK , Version 1.31, Patch B, full run users
CC540A_D.EXE	CODECALC , Version 5.40, Patch A, dealers

Insure you obtain the correct ESL version of a particular patch. If the patch does not match your ESL, and you install it, the software will not function. You will receive error messages that the ESL can not be found, or you have an improper version.

Can Patches Be Applied to Any Version?

NO! As new versions are released, additional input items become necessary and must be stored in the program data files. In addition, file formats change, data bases grow, and so on. A patch file is intended for one specific version of the software. Using a patch on a different version (with out specific advice from COADE personnel) is a sure way to cripple the software.

How Are Patches Announced?

When a patch becomes available, the NEWS file maintained on the BBS and WEB sites is updated. All entries in this news file are dated for ease of reference. Users should check one of these news files at least once a month to insure they stay current with the software.

Corrections and Patches are also published in *Mechanical Engineering News*, COADE’s Technical Newsletter.

How Are Patches Obtained?

Patches are posted to both the COADE Bulletin Board System (BBS) at (713) 890-7286 and COADE’s Internet WEB site (www.coade.com). The patches are arranged in directories by program. Each file is annotated with a short description, describing the contents of the file.

Decide which patch file you need, and simply pick it to download it.

What Is Contained in a Specific Patch?

Each patch file contains a file named PATCH_x.TXT, where the “x” represents the patch ID letter. This is a plain ASCII text file. It can be viewed with any text editor or simply printed on the system printer. This text file contains a description of all corrections and enhancements made, which are contained in the current patch. When necessary, additional usage instructions may be found in this file.

How Are Patches Installed?

As discussed above, the patch files are self-extracting programs. Simply running this .EXE file will extract the patched files. Usually, there is nothing else to do. However, you should always review any .TXT files included in the patch. When running the .EXE patch file, you should include the “-O” command line argument. This will run the patch in “overwrite” mode, which will avoid prompting you for permission to replace exiting files.

For example, **CAESAR II** Version 3.23 Patch B was posted as a 3 Mbyte file — too large to move between machines on 1.44 Mbyte floppy diskettes. When this patch file is executed, three sub-archives and two .TXT files are extracted. The README.TXT file explains that the sub-archives contain the actual patches to **CAESAR II**, and that they have been setup so that each is smaller than 1.44 Mbytes to facilitate moving the patch to other machines.

How Can a Patch Be Detected / Checked?

When a patch is ready to be released, the Main Menu module is revised to reflect the patch level. This allows the user to see, on the Main Program Menu, which patch level is in use. To see which program modules have been patched, you can run a COADE utility program from within the program directory.

At the DOS prompt in the program directory, issue the command:

```
COADEXE [Enter]
```

This will produce a display window which scrolls information about each of the programs found in the directory. A sample display from this utility is shown in the table below. This table lists, for each program, the name, the file size, the memory requirement, and the patch level.

```

- COADE EXE SCANNER, VER 1.02, 1995 -
PROGRAM  FILE SIZE  MEMORY  PATCH LEVEL

  DYN.EXE   293398    15606   C2_3.23
ACCTNG.EXE 118714    125034  C2_3.23
  AISC.EXE  264056    348632  C2_3.23a
ACADX.EXE  157809    15606   C2_3.23
ANAL1.EXE  442251    15606   C2_3.23
  C2.EXE    12380     14652   C2_3.23
C2DATA.EXE 261659    15606   C2_3.23
C2EDIT.EXE 58940     350124  C2_3.23
C2SETUP.EXE 119962    174682  C2_3.23b
  IECHO.EXE 491116    15606   C2_3.23
INCORE.EXE 211739    15606   C2_3.23
  M1P1.EXE 303914    384794  C2_3.23b
OUTCORE.EXE 212795    15606   C2_3.23
  OUTP01.EXE 338524    15606   C2_3.23a
  OUTP02.EXE 718678    15606   C2_3.23b

```

Reviewing this table shows which modules have been patched and to what level.

Archiving and Reinstalling an Old, Patched Version?

When a new version of the software is released, what should be done with the old, existing version? The distribution disks sent from COADE should obviously be saved. Additionally, any patches obtained should also be archived with the original diskettes. This will allow full usage of this version at some later time, if it becomes necessary.

To reinstall an older version of the software, the distribution diskettes from COADE should be installed first. Then, each patch should be applied, **IN ORDER!** It is very important that patches are applied in A, B, C order. Patch B does not include Patch A, for space and download time reasons. The possibility exists that Patch B may alter a file previously altered in Patch A. Therefore, Patch B must be installed after Patch A in order to obtain all revisions to a particular file or program.

Future Improvements to the Patching Process

COADE is working towards an *Incremental Patching Procedure*, which will distribute only the changed portions of program files. A utility will be provided to combine the changed portions, with the current software on the User's machine to obtain the patched version. Additionally, a file named PATCH.VER will reside in the program directory with information detailing the current patch status of the software.

This incremental patching facility will mean that the patch distribution files will be much smaller (then the entire patched module), and that the download times from the Internet or BBS will be cut substantially. The only requirement to utilize this procedure is that *all* the patches must be applied, *in order*. For example, Patch D can only be used by applying it to Patch C. Patch D can not be applied to the base version, or to Patch A, or to Patch B.

API-653 Tank Bottom Inspection and Evaluation

By: Vincent A. Carucci, President, Carmagen Engineering, Inc., 7 Waverly Place, Madison, NJ 07940

API-653 states that leaks in tank bottoms are not acceptable while tanks are in service. It goes on to state that periodic assessment of tank bottom integrity shall be performed. API-653 does not mandate exactly how to perform this integrity assessment, what inspection techniques to use, nor the extent of the inspection. These items are left for the tank owner to determine. Several points are worth keeping in mind:

- Saying that a leak is not acceptable is potentially a more stringent requirement than saying that a structural component cannot exceed its allowable stress. A leak of any size is not acceptable, even a pinhole or small crack.
- The tank owner must decide what inspection technique(s) to use and how extensive the inspection must be in order to assure himself that the bottom will not leak. There are conflicting aspects to this. Performing extensive inspection increases the probability that problem areas are located, but inspection costs increase as the amount of inspection increases. Keep in mind, though, that relatively small areas of severe corrosion could eventually hole through and leak. In addition, the increased costs associated with a

thorough inspection are often small when compared to the total cost of taking a tank out of service, cleaning it, and preparing it for inspection.

- Both topside and underside corrosion and pitting, and their associated rates, must be considered.
- The integrity evaluation must consider any additional corrosion or pitting that will occur during the entire next period of tank operation (i.e., between the current inspection and when the tank bottom will next be inspected). Owners want to maximize the period between bottom inspections because of operational and cost considerations.

Bottom Plate Thickness Evaluation

API-653 specifies minimum acceptable thicknesses for the tank bottom plate and annular plate in Table 4-1 and Para. 2.4.8 respectively. It also indicates that the remaining thicknesses of the bottom may be quantified using either a “probabilistic” method or a “deterministic” method. The bottom plate thicknesses are then compared to the required thicknesses to determine their acceptability.

The probabilistic method uses a statistical approach to extrapolate a relatively small amount of inspection data into a prediction of whether the tank bottom is too thin. This method has proven to be an accurate minimum thickness prediction technique, but it doesn’t indicate the location of the minimum thickness. If it indicates that the bottom is too thin, a more extensive inspection must be done to actually locate the thin areas.

The deterministic method uses more extensive inspection data to quantify the remaining thickness of the bottom. The required data includes the following:

- Original plate thickness
- Average and maximum depth of internal and underside pitting
- Maximum internal and underside pitting rates and maximum general corrosion rate
- Average depth of general corrosion
- The time until the next inspection

Current trends appear to be directed toward increased use of the deterministic approach.

Bottom Plate Thickness Measurement

From an evaluation standpoint, it would be ideal to have a complete thickness map of the bottom. However, it would be expensive and time consuming to perform the ultrasonic inspection that is necessary to do that, and such an extensive survey is not necessary. A bottom thickness inspection approach that is now commonly used is to employ Magnetic Flux Exclusion (MFE) inspection equipment to inspect the tank bottom. We won’t go into the theory of how MFE equipment works here. However, the technique requires that the MFE equipment be set to a bottom thickness threshold (typically approximately 70% of the original plate thickness) and then it is used to scan the entire bottom (like walking behind a lawnmower). The MFE equipment will identify any locations that are thinner than the threshold setting, but it will not necessarily quantify the thickness. Follow-up UT measurements are then made at the thin areas that were identified by the MFE. The thickness data are then used to perform a deterministic evaluation of the bottom. The MFE testing with follow-up UT inspection is a cost-effective approach to bottom plate thickness inspection. However, several points must be kept in mind:

- It is common that most, and sometimes all, of a tank bottom passes the MFE scan. This “clean bill of health” does not mean that there is no corrosion or pitting. It only means that corrosion and pitting does not exceed the threshold setting of the equipment. In the absence of other data, it must be assumed that corrosion and/or pitting has occurred at least to the threshold level limit. The corrosion and/or pitting rates must consider this threshold level as well. Since the extent of general corrosion and internal pitting are easily determined, the threshold level has the largest potential effect on the underside pitting amount and rate. Put simply, a clean MFE scan means that there is no (underside) corrosion or pitting that has caused thinning below the threshold setting.
- MFE equipment cannot inspect near the bottom plate lap welds or at the bottom-to-shell junction weld. The lap welds must be vacuum box tested for cracks and the junction weld should typically be MT inspected.
- Smaller MFE tools are required for hard to reach areas such as in sumps or under heating coils.

TANK and Bottom Plate Thickness Evaluation

The **TANK** program can assist in evaluating the acceptability of the bottom plate thickness using the deterministic method of API-653.

Referring to Para. 2.4.7.1 of API-653, there are two equations that are used to determine the minimum remaining bottom plate thickness, MRT_1 and MRT_2 .

$$MRT_1 = T_o - GC_a - StP_a - UP_m - (StP_r + UP_r + GC_r)O_r$$

$$MRT_2 = T_o - GC_a - StP_m - UP_a - (StP_r + UP_r + GC_r)O_r$$

Where:

MRT_1 = Minimum remaining thickness at the end of the in-service period based on average internal pitting and maximum external pitting, in.

MRT_2 = Minimum remaining thickness at the end of the in-service period based on maximum internal pitting and average external pitting, in.

T_o = Original plate thickness, in.

GC_a = Average depth of generally corroded area, in.

StP_a = Average depth of internal pitting, measured from the original thickness, in.

StP_m = Maximum depth of internal pitting remaining after repairs are completed, measured from the original thickness, in.

UP_m = Maximum depth of underside pitting, in.

UP_a = Average depth of underside pitting, in.

StP_r = Maximum internal pitting rate, in./year

UP_r = Maximum underside pitting rate, in./year

GC_r = Maximum rate of general corrosion, in./year

O_r = Anticipated in-service period of operation, years

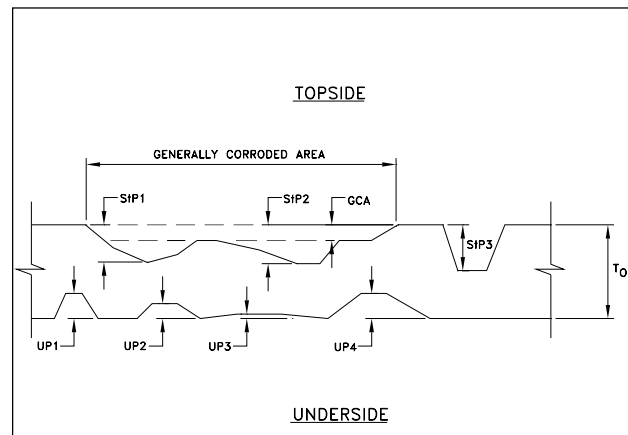
Figure 1 illustrates several of these parameters. Referring to Figure 1:

$$StP_a = (StP_1 + StP_2 + StP_3 + \dots + StP_n)/N$$

$$StP_m = \text{Maximum of } (StP_1, StP_2, StP_3, \dots, StP_n)$$

$$UP_a = (UP_1 + UP_2 + UP_3 + UP_4 + \dots + UP_n)/N$$

$$UP_m = \text{Maximum of } (UP_1, UP_2, UP_3, UP_4, UP_n)$$



Parameters for MRT Equations
Figure 1

The following simple examples illustrate how **TANK** can be used to evaluate tank bottom thicknesses.

Example 1

After 42 years of operation, a tank has been taken out of service for an API-653 bottom plate evaluation. The original bottom plate was 0.25 in. thick. There is no internal lining nor cathodic protection (CP) system installed. There are no means for bottom leak detection or secondary containment considerations. It is desired to keep the tank in service for at least 10 years after this inspection.

The bottom was given a general visual inspection to identify any obvious areas of general internal corrosion or pitting. Pit depth measurements were made as required. Five UT measurements were made in each plate in order to identify any general corrosion that had occurred. The entire bottom was also inspected using an MFE floor scanner that was set such that any thinning in excess of 25% of the original plate thickness was identified. Detailed ultrasonic thickness (UT) measurements were then made in all thin areas identified by the floor scanner. The following inspection data were reported:

- No internal pitting.
- Average depth of general internal corrosion is 0.001 in.
- Maximum depth of general internal corrosion is 0.020 in.
- The MFE floor scanner identified plate thinning in excess of the setting in 14 locations in six different plates. All the thinned locations are more than 12 in.

from the junction between the annular plate ring and the bottom plate. Since no internal pitting or corrosion were identified in these areas, these thinned areas are due to underside pitting. Follow-up UT measurements in these thinned areas found that the pitting ranged from 0.07 in. to 0.15 in. deep, with an average depth of 0.1093 in.

Corrosion rates and pitting rates must first be calculated. Since no other inspection data is available, it must be assumed that the measured corrosion and pitting occurred at a uniform rate over the entire 42 years of service. In each case, the rates are calculated based on the maximum general corrosion and pitting that was measured, not the average values.

$$GC_r = 0.02/42 = 0.0005$$

$$UP_r = 0.15/42 = 0.0036$$

$$STP_r = 0$$

With these preliminary calculations made, the parameters can be input to the program as follows:

```

Average Depth of Generally Corroded Area (GCa) ... (in.)          .10000E-02
Maximum Rate of General Corrosion (GCr) ..... (in./year)       .50000E-03
Max Depth Internal Pitting After Repair (StPm) ... (in.)         .00000
Maximum Internal Pitting Rate (StPr) ..... (in./year)          .00000
(0 if lined)
Maximum Underside Pitting Rate (UPr) ..... (in./year)          .36000E-02
(0 if cathodically protected)
Anticipated In-Service Period of Operation (Or) (years)         10.000

TANK BOTTOM SERVICE MEASUREMENT DATA
Average Depth of Internal Pitting (StPa) ..... (in.)           .00000
Maximum Depth of Underside Pitting (UPm) ..... (in.)           .15000
Average Depth of Underside Pitting (UPa) ..... (in.)           .10930
Original Plate Thickness (To) ..... (in.)                       .25000
    
```

The following is the relevant portion of the program output based on these parameters:

```

API-653 Section 2.4.7.1 Minimum Thickness of Bottom Plate
MRT1 (avg internal, max external pitting) ..... (in. )         .58000E-01
MRT2 (max internal, avg external pitting) ..... (in. )         .98700E-01
    
```

Both MRT_1 and MRT_2 are less than the minimum acceptable value of 0.1 in. that is required by Table 4-1 of API-653. Therefore, something needs to be done.

Since, at most, only six plates thinned excessively, the most logical course of action is to replace the thinned portions of plate. In order to minimize the necessary work and avoid replacing the entire plate in each case, TANK can be used in a trial and error process to determine an acceptable amount of thinning that can still remain in the bottom after repair. For example, assume that all areas that had underside pits deeper than 0.1 in. were replaced. The new value for UP_m would then be 0.1 in. A new value for UP_a would have to be calculated based on the remaining underside pitting (assume UP_a to be 0.0971 in. for this example). The pitting rates that were used originally would remain unchanged because nothing is being done to change the rates. Putting the

revised values for UP_m and UP_a into the program yields the following result:

```

API-653 Section 2.4.7.1 Minimum Thickness of Bottom Plate
MRT1 (avg internal, max external pitting) ..... (in. )         .10800
MRT2 (max internal, avg external pitting) ..... (in. )         .11090
    
```

Since both MRT_1 and MRT_2 are more than the minimum acceptable value of 0.1 in., this amount of repair is acceptable to achieve the desired 10 year in-service period.

Example 2

After 17 years of operation, a tank has been taken out of service for an API-653 bottom plate evaluation. The original bottom plate was 0.25 in. thick. There is no internal lining nor cathodic protection (CP) system installed. There are no means for bottom leak detection or secondary containment considerations. It is desired to keep the tank in service for at least 10 years after this inspection.

The following inspection data were reported:

- Scattered internal pitting to a maximum depth of 0.03 in. throughout the tank. Deeper pitting at 10 separate locations in three different plates. The maximum measured pit depth at these latter locations is 0.11 in and the average depth is 0.09 in.
- No general internal corrosion.
- The MFE floor scanner was set such that it could identify plate thinning that was in excess of 20% of the original plate thickness of 0.25 in. The entire bottom was scanned “cleanly” (i.e., the remaining thickness is at least 0.2 in. throughout). Note that this also means that underside pitting of up to 0.05 in. deep could still be present but just not identified by the scanner. Therefore, both the average and maximum underside pit depths must be assumed to be 0.05 in.

Corrosion rates and pitting rates must first be calculated as was done in Example 1.

$$GC_r = 0 \text{ (i.e., no general internal corrosion reported)}$$

$$UP_r = 0.05/17 = 0.0029$$

$$STP_r = 0.11/17 = .0065$$

With these preliminary calculations made, the parameters can be input to the program as was done in Example 1. The following is the relevant portion of the program output based on these parameters:

```
API-653 Section 2.4.7.1 Minimum Thickness of Bottom Plate
MRT1 (avg internal, max external pitting) .....(in. ) .16000E-01
MRT2 (max internal, avg external pitting) .....(in. ) -.40000E-02
```

These results are well under the minimum acceptable value of 0.1 in.; therefore, repairs are necessary.

In this case, internal pitting is clearly a problem. Since there are only 10 locations with pitting deeper than the general 0.03 in., it is easy to repair these either by patch plates or local weld overlay. If this is done, the average and maximum internal pit depths would then be 0.03 in. The underside and internal pitting rates would remain the same as before. Rerunning the program yields the following results:

```
API-653 Section 2.4.7.1 Minimum Thickness of Bottom Plate
MRT1 (avg internal, max external pitting) .....(in. ) .76000E-01
MRT2 (max internal, avg external pitting) .....(in. ) .76000E-01
```

While these repairs addressed all the deeply pitted areas, the results are still not acceptable. Only very mild pitting was left on the topside (0.03 in.), and the floor scanner setting permitted anything deeper than 0.05 in. to be detected. However the problems are the topside and underside pitting rates which have not been addressed by just the pit repairs (i.e., future pitting at the maximum rates can still occur in the future). The topside pitting rate is still based on the deepest internal pit that was originally found (not the deepest that was left after repair). The underside pitting rate must still be based on the possibility that underside pitting of up to 0.05 in. was undetected. Therefore, at least one of the pitting rates must also be addressed in order to achieve the desired 10 year service interval.

A CP system may be installed that would then reduce the future external pitting rate to zero. As an alternative, an internal lining may be installed that would then reduce the future internal pitting rate to zero. Since the underside pitting rate is less than half of the internal rate (0.0029 vs. 0.0065 in./year), recalculations are first done assuming that a CP system is installed (in addition to the internal pit repairs) and the underside pitting rate goes to zero. The results are as follows:

```
API-653 Section 2.4.7.1 Minimum Thickness of Bottom Plate
MRT1 (avg internal, max external pitting) .....(in. ) .10500
MRT2 (max internal, avg external pitting) .....(in. ) .10500
```

These results are acceptable. It can also be stated that installing an internal lining on the bottom rather than a CP system would also yield acceptable results because eliminating the larger internal pitting rate would yield even better results. Therefore the choice between installing an internal lining or a CP system may be based on cost.

Summary

Integrity evaluation of the bottom plate requires a good understanding of inspection techniques, their limitations, and acceptance criteria. Since even a small leak is not acceptable and stress is not a primary consideration, a thorough inspection and proper interpretation and use of the inspection data is critical. The **TANK** program can assist in making the required evaluations.

A Technique for the Analysis of Non Simultaneously Thermally Displaced Piping Systems (Hot Tapping)

By: John C. Luf, Morrison Knudsen Corporation, Cleveland, Ohio U.S.A.

The title above is as descriptive as I could get for the following scenario: An existing hot piping system is being tied into by a new piping system. The tie in will occur at an isolation valve in the existing system. The existing system will not be shut down at the time of the tie in and the new system will be completely installed prior to the connection. How do we analyze for this? Some things I've done in times past have been:

- 1) Try to make the tie-in point adjacent to an existing anchor type restraint. Analyze the new system separately and impose the end reactions by hand calculation to the existing system to make sure that the existing support and branch were not overloaded.
- 2) Estimate the existing system's displacements at the tie-in point, analyze the new system separately with the displacement and impose the end reactions by hand calculation to the existing system to make sure that the existing support and branch are not overloaded.

The above methods are adequate for some cases but the engineer must constantly ask the question "Which portion of the system is the tail and which part of the system is the rest of the dog?" In other words by analyzing the new work separately, the exact interaction between the existing piping and new work is lost.

For critical, heavily loaded piping systems the disconnected approach may lead to incorrect and unacceptable conclusions. Pondering just such a system allowed me to ask the question “How would I analyze this system manually?”

In the 1930’s Sam W. Spielvogel developed and published one of the first methods for analyzing displaced piping systems. His method was the basis for the approach I present in this article. In Spielvogel’s approach a simple L bend, for instance, would be analyzed as follows:

With one end fully fixed, calculate the thermal expansions of the free end.

- 1) Determine the starting (non thermally displaced) centroid of the system .
- 2) Determine the thermally displaced centroid of the system .
- 3) By calculation method fasten the rigid bracket to the freely displaced end and apply the forces required at the thermally displaced centroid to bring the freely displaced end back to its starting position.

What the previous paragraph implies is that the pre-displaced piping can be taken into account. The method used would be to perform the analysis using the following procedure:

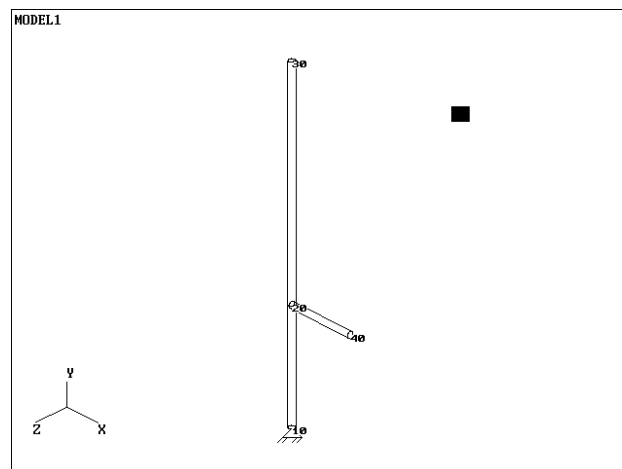
- 1) Create a model with the existing piping at the temperature profile at which it will be operating during the time of construction and tie-in of the new piping. The new portion of the system would be modeled with the installation temperature. A node point should be placed at every point of restraint in the new system, but the restraints themselves should be omitted.
- 2) A thermal only $\{T_1 \text{ (OPE)}\}$ analysis should be conducted, and displacements and rotations appropriate to the boundary condition (support/guide/restraint) should be noted. A list of some of these follows:

Description	C2 restraint Condition	Displacement / Rotations to note
Clevis Hanger w/ low θ angle	+Y	Y Movement
Spring Hanger w/ low θ angle	Spring Hanger	Y Movement
Lateral Guide	X / Z / GUI	Horizontal Movement perpendicular to axis of pipe element
Anchor	ANC	All displacements and rotations

Note: T1=Normal operating conditions.

- 3) The file should then be copied into a new file name, the complete system should be given the temperature profiles used for its analysis (i.e. normal, maximum, and minimum conditions). Hangers and restraints, should be installed at the pre-selected node points; these in turn should be connected to **CNODEs**. The connecting nodes should be displaced as is appropriate for the restraint from data taken from the thermal only analysis. Load case definitions must be defined carefully to incorporate the imposed displacements properly.

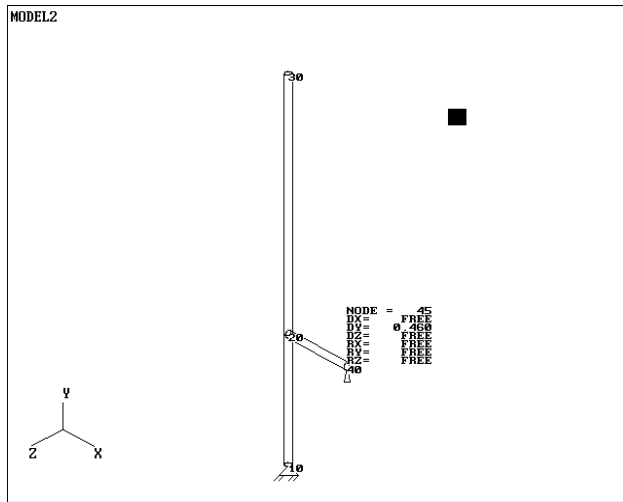
A SIMPLE EXAMPLE:



Examine the plot of model 1. This model will have the existing piping system represented as elements 10 - 20 and 20 - 30. The “new” piping will be element 20 - 40. Lets assume that at node 40 we wanted to install a simple +Y support. Following the above procedure we find the displacements for T1 at node 40 to be as shown below. We will use the displacements for T1 in our analysis because this represents the operating line's temperature profile at the time of tie-in.

CAESAR II Ver 3.23 Job: MODEL1 Date SEP 2,1996 Time 12:59 Page: 1
 DISPLACEMENT REPORT, Nodal Movements RUN FOR THERMAL DISPLACEMENT
 CASE 1 (OPE) T1

NODE	Translations(in.)			Rotations(deg.)		
	DX	DY	DZ	RX	RY	RZ
10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.0000	0.4598	0.0000	0.0000	0.0000	0.0000
30	0.0000	1.3795	0.0000	0.0000	0.0000	0.0000
40	0.0000	0.4598	0.0000	0.0000	0.0000	0.0000



The next step following the procedure above is to copy the file and incorporate the displacements with supports. Model 2 is the file used for this (see the adjacent plot).

The load cases set up for this analysis are as follows.....

- CASE 1 (OPE) W+DIS+T1+P1 (Normal operating conditions)
- CASE 2 (OPE) W+DIS+T2+P1 (Maximum operating conditions using installed displacement @ the point of support)
- CASE 3 (OPE) W+DIS+P1 (Minimum operating conditions “system shutdown”)

- CASE 4 (SUS) W+P1 (Sustained Stresses)
- CASE 5 (EXP) D5(EXP)=D1-D3 (Displacement stresses for “Normal operating conditions)
- CASE 6 (EXP) D6(EXP)=D2-D3 (Displacement stresses for “Maximum operating conditions)

A review of the restraint summary reveals some interesting points:

Node	Case	Type	Forces (lbs.)			Moments (Ft. Lbs)		
			FX	FY	FZ	MX	MY	MZ
10		Rigid	ANC					
	1	OPE	0	-832	0	0	0	-16
	2	OPE	0	-905	0	0	0	-453
	3	OPE	0	-323	0	0	0	3043
	4	SUS	0	-832	0	0	0	-15
	5	EXP	0	510	0	0	0	3058
40		Rigid	+Y					
	1	OPE	0	-73	0	0	0	0
	2	OPE	0	0	0	0	0	0
	3	OPE	0	-583	0	0	0	0
	4	SUS	0	-73	0	0	0	0
	5	EXP	0	-510	0	0	0	0
6	EXP	0	583	0	0	0	0	

Node	Case	Type	Forces (lbs.)			Moments (Ft. Lbs)		
			FX	FY	FZ	MX	MY	MZ
45		Displ.	Reaction					
	1	OPE	0	-73	0	0	0	0
	2	OPE	0	0	0	0	0	0
	3	OPE	0	-583	0	0	0	0
	4	SUS	0	-73	0	0	0	0
	5	EXP	0	-510	0	0	0	0
6	EXP	0	-583	0	0	0	0	

- 1) The restraint node(40) +Y and the displaced connecting node(45) reactions are equal.
- 2) Node 40 has minimal load acting on it during case 1, indicating this it its “neutral” (installed) condition.
- 3) The load at node 40 transfers to node 10 during case 2 as the support at 40 lifts off during the maximum temperature case.

- 4) Node 40 has zero load acting upon it during case 2, confirming its liftoff.
- 5) During the case 6 analysis load reversal occurs due to the “displaced” hanger at node 40, so the maximum load range is 583 lbs.

Total displacement Stress Range:

A reversal of loading occurs during the minimum temperature analysis. This illustrates one of the hard to see problems with this work. This reversal is caused by the vertical riser “shrinking” and pulling down on the +Y at node 40. The stress caused by this mechanism is automatically obtained and algebraically summed with the other stress range, by the use of the rather unique load case combinations listed previously, i.e. displacements from load cases D1 and D2 being summed against the D3 case. The stress caused by this mechanism can be seen in expansion cases 5 & 6, defined above.

Support lift off?:

Obviously the +Y at 40 will lift if the temperature of the riser would increase above the tie in temperature. It is the writer's opinion that if the support lift off is not a large displacement, and the pipe can eventually relieve itself and sag to rest on the support the lift off can be ignored. However the lift off of fixed supports needs to be considered on a case by case basis. In this example, for instance, the displacement of node 40 between T1 and T2 is quite small (0.1027”), however it appears unlikely that the line will develop enough sag over time to make contact. Therefore, I would remove this support from the system, or if a support was required at this location to either 1) lower the sustained stresses or 2) reduce the load and moment at node 10 I would use a spring can at 40.

Why OPE for T only analysis?:

CAESAR II uses the commands of OPE, SUS, OCC, and EXP to sum and compare calculated system stresses to the code allowable stress values. The use of the OPE command tells **CAESAR II** that the system stresses it may calculate are not to be compared to a code stress value. Because this T only analysis does not comply with the code intent for *algebraic summation* and because it did not have all the boundary conditions I did not want to confuse it with a code related load case.

What if my existing system has displacements (such as equipment growth) imposed at the end points?:

The T only analysis should be a T+D analysis. Or rigid elements for the equipment (at the correct temperature range) can be added to the model. Remember what you are trying to acquire is the existing system's displacements on the new work at points of restraint.

How much of the existing system should be modelled?:

This topic itself is controversial; in my opinion, if the piping that you are analyzing is important enough for this treatment, then you should model into the existing system far enough to establish the reasonable boundary conditions which will affect the new piping.

Summary:

This technique, although it may be somewhat bewildering, is useful for critical piping systems with hot tie-in work. Analysis at all temperature ranges including the minimum temperature may reveal interesting reversals. The work done in the early days of this industry involving the analysis of thermally displaced piping systems is still a sound basis for extrapolation to modern day methods.

ASCE 95 Wind Code Revision

By Scott Mayeux

Earlier this year the American Society of Civil Engineers revised the long standing ASCE 93 wind design code. The ASCE published and released in 1993 a version of the wind design code which was essentially a rewrite of former American National Standard A58.1. The 93 version of the wind design code was based on a fastest mile wind velocity criteria. As we shall see, the 95 edition changes this.

For structural, piping and pressure vessel design the essential item we are concerned with is the load imposed on the structure due the effect of the wind. ASCE in its 1993 version gives a concise equation which allows one to solve for the wind pressure at a given elevation. The basic form of the wind pressure equation is :

$$qz = 0.00256 Kz (I V)^2$$

where qz is the wind pressure at elevation z (psf)

0.00256 is the standard air mass density for a standard atmosphere

<p>Kz is the velocity pressure coefficient defined by a power law type equation</p> <p>I is the importance factor</p> <p>V is the basic wind speed from ASCE Fig. 1 (mph.)</p> <p>The factor Kz can be computed using ASCE 93 Table C6 when the exposure category and elevation are known. Once the wind pressure is known, the force generated can be calculated knowing the diameter, length, orientation, wind shape factor and gust response factor.</p> <p>In 1996 ASCE published a new wind design standard. This new standard is based on a 3 second gust criteria. In creating this new standard several parameters in various tables were changed to account for the research ASCE did in its field data collection. In doing so the basic wind pressure equation was changed. The new equation is :</p> $qz = 0.00256 Kz Kzt I V^2$ <p>where Kzt is a topographic factor which is equal to $(1 + K1 K2 K3)^2$</p> <p>where K1, K2 and K3 are multipliers used to account for the speed up effect as wind traverses a hill or escarpment.</p> <p>If the piping system or vessel is not on hill top, the value of Kzt would be equal to 1.0 and would not have an effect on the computed wind pressure. It is also interesting to note that values of the importance factor now range between 0.87 and 1.15, whereas before the range was 0.95 to 1.11 and I is not squared. Additionally, the structural classification table has changed in the new 95 edition.</p> <p>If you are going to be using the 95 edition of the wind code, please procure a copy of it and read it carefully, especially the commentary in the latter part of the publication. This new wind design code has been implemented in PVelite Version 2.00, and will be implemented in CAESAR II Version 3.24 and CODECALC Version 5.60.</p>	<p>Figure 2-1</p> <p>Sect 2.2.9.1</p> <p>Sect 2.5.5.2b</p> <p>Sect 2.5.5.3c</p> <p>Sect 3.1.5.4</p> <p>Sect 3.7.4.1</p> <p>Sect 3.7.4.3</p> <p>Sect 3.7.4.3</p> <p>Sect 3.7.4.5</p> <p>Table 3-8</p> <p>Sect 5.2.3.5</p> <p>Sect 5.3.7.2</p> <p>Sect 6.1.8.1</p> <p>Sect 7.4</p> <p>Sect A.2.2</p> <p>Sect G.4.2.4</p> <p>Sect I.1.1</p>	<p>Group VIA has been added to the curve for Group VI.</p> <p>The toughness requirements of plate-ring flanges, blind flanges, and manhole cover plates is specifically addressed.</p> <p>Changes Group VI to Group VIA.</p> <p>This section now specifically defines the governing thickness of bolted blind flanges and manhole covers as 1/4 of their nominal thickness.</p> <p>Now states that the lapping of two bottom plates on the butt-welded annular plate does not constitute a three-plate lap weld.</p> <p>Reference section changed from 3.7.4.4 to 3.7.4.3.</p> <p>Now states that the maximum thermal stress-relieving temperature shall not exceed the tempering temperature.</p> <p>New section for relieving below 1100 degrees F.</p> <p>Dimensions for "low type C" nozzles with threaded fittings are now referred to Section 3.7.3.</p> <p>Refines the definition of the area to be examined visually and by magnetic particle methods.</p> <p>Clarifies that the tank is not designed to be "gas tight".</p> <p>Rephrases the requirements of radiographic examination record keeping.</p> <p>The identification of Welded Joints is restated.</p> <p>Adds that Group III and IIIA materials must also meet the requirements of Sect 7.2.2.</p> <p>Revised the constant in the seismic force equation from 0.24 to 0.60.</p> <p>Adds a new note stating that API encourages the installation of a Release Prevention Barrier.</p>
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API-650 9th Edition, Addendum 2 Published

This article briefly describes some of the changes made in Addendum 2 to the 9th edition of the API-650 code, *which will affect the COADE TANK program*. Note, this should by no means be considered a complete list of all of the differences between these two editions.

Sect J.4.2.2	Expands the scope from Sect 5.3.6 to Sect 5.3.7.	Sect 3.1	Clarifies that brittle fracture evaluation procedures do not supplement or replace hydrotest requirements.
Sect J.5	Now allows spot radiography to be omitted for shop-assembled tanks when a joint efficiency of 0.70 is used.	Sect 4.2.1.k	An additional statement has been added to this paragraph, listing a change in service as an inspection consideration.
Table K-1	Revised column of weights.	Sect 4.3.2.2	Sub-paragraph "a" of the 1 st edition, addressing new tanks, has been removed from the 2 nd edition.
Table K-2	Revised column of weights.	Sect 4.3.3.3	Clarifies that internal inspections can be substituted for external UT measurements if the inspection interval is less than that required by Sect 4.3.3.2.b.
Table K-3	Revised column of weights, and noted that one thickness exceeds the maximum allowed for the material.	Sect 4.4.1.2	New paragraph stating that formal internal inspections must occur at defined intervals.
Appendix S	This is a completely new appendix addressing stainless steel materials.	Sect 6.4.3	This paragraph of the 1 st edition has been deleted from the 2 nd edition. Sections 6.4.4 and 6.4.5 have been renumbered to 6.4.3 and 6.4.4 respectively.

API-653 2nd Edition Published

This article briefly describes some of the differences found between the 1st and 2nd editions of the API-653 code, *which will affect the COADE TANK program*. Note, this should by no means be considered a complete list of all of the differences between these two editions.

Sect 2.3.2.1b *	The equation for "L" in the 2nd edition is now in error. The term Dt_2 should be $\sqrt{Dt_2}$.	Fig 7-1	This figure has been modified to address new vertical welds and minimum distances.
Sect 2.3.3.1	In the definition of the joint efficiency (E), the 1 st edition required a value of 0.70 if the original efficiency was unknown. The 2 nd edition provides a table of efficiencies based on the type of joint and the edition/year of the code when the tank was constructed.	Sect 7.8.2.2 *	This paragraph refers to reinforcing plates on existing shell penetrations. The 1 st edition referred to Fig 7-2. The 2 nd edition refers to Fig 6, which is most likely a mistake.
Sect 2.4.1	Added that leak detection methods must satisfy the requirement for periodic assessment between internal inspections.	Sect 7.9.2.2	The paragraph on bottom replacement has been expanded with two new sub-paragraphs.
Sect 2.4.5	The paragraph discussing Bottom Leak Detection has been clarified by the addition of Note #1.	Sect 7.9.2.3	New paragraph discussing new tank bottom replacement.
Sect 2.4.7.4	This is a <i>new</i> paragraph which discusses the minimum bottom plate thickness in the critical zone, if a stress analysis is not performed.	Sect 7.9.2.4	New paragraph warning against galvanic corrosion when replacing tank bottoms.
Sect 2.4.8.1 *	The minimum thickness of the annular plate ring has been changed from 0.10 inches to 1.10 inches. (This is most likely an error in the new edition, since the value 1.10 does not correspond to the values in Table 2-3.)	Table 10-1 *	In the 2nd edition, the reference to Figure 8 in column A, item 1 is incorrect. It should be Figure 10-1.
		Sect 10.3.2.3a	This paragraph has been changed from stating specific requirements for door sheets, to a reference to Table 7-2.
		Page 11-1 *	In the 2nd edition, the first reference to Section 11.3 should be removed. This is a reprint of part of Sect 11.2.3, with the text from Sect 11.3.

- Fig 11-1 * **The Nameplate of the 2nd edition contains incorrect column headings. The second column should be "Allow. Stress" and the third column should be "Matr1".**
- Sect B.1.3 The 2nd edition revised this paragraph to state lifting 1/2 the tank shell, instead of the total shell.
- Sect B.2.2.4c * **In the first line, the word "plate" should be "plane".**
- Fig B-3 * **The equation for S_i is now incorrect in the 2nd edition.** The first inner term now reads $1/2U_i$, it should be $1/2U_{i-1}$. The example is however correct.

PC Hardware & Systems for the Engineering User (Part 22)

By Richard Ay

Configuring Windows 95 For Usage -- Part I (Part II of this article will be presented in the next issue of COADE's Mechanical Engineering News.)

(Note, COADE takes no responsibility for any of the changes you may make to your system as a result of this article. Furthermore, COADE does not offer support on Windows 95, Windows NT, or any other operating system. Any custom configuration at the operating system level should be performed by knowledgeable system personnel only!)

As most people know, Windows 95 is becoming more and more prevalent. Windows 95 is a much more complex operating system than either Windows 3.x or DOS. Unfortunately, the default installation and configuration of Windows 95 is not optimum, especially if you purchase a new machine which comes with Windows 95 pre-installed. This article discusses changes *you may want to make* to your Windows 95 system to obtain better performance. Before making any changes, be sure you understand fully what you are doing - and have a backup available in case of problems.

Partition Size

A very important change necessary for new systems is to adjust the partition size of the disk drive. Most hardware vendors supply machines configured for only a single logical drive, Drive C, regardless of how big the drive is physically. Most new hard drives today are at least 500 Mbytes. For these drives, configured as a single logical drive, the cluster size is 8 Kbytes. This means that if you create a file with a

single character, which really only takes 1 byte, the file size is a minimum of 8 Kbytes. If your machine comes with a 1 Gbyte drive setup as a single logical drive, the cluster size is 16 Kbytes. The same single character file now consumes 16 Kbytes of disk space. If your machine comes with a 2 Gbyte drive setup as a single logical drive, the cluster size is 32 Kbytes. The same single character file now consumes 32 Kbytes of disk space. Each and every file on the hard disk has some overhang into "one final cluster". The larger the cluster size, the more disk space is wasted in this overhang region. On a 2 Gbyte drive, this overhang can amount to 40% of the drive, that is 800 Mbytes are unavailable for use!

Many users simply suffer with this wasted space, due to the previous painful solution: backup everything, re-partition the physical drive into several logical drives (C:, D:, etc.), format each drive, and finally reinstall all the software and data files. When a new system comes with a new, pre-installed, unfamiliar operating system, this process is the last thing that should be attempted. Recently a solution to this problem has been developed. A software program (Partition Magic) from PowerQuest is capable of re-sizing partitions without reformatting the drive. Partition Magic has been successfully used at COADE to re-partition 2 Gbyte drives from a single logical drive to four logical drives. If you want to use your large disk drives effectively, this is "must have" software. (PowerQuest can be reached at 808-226-8977.)

Turning off the Windows 95 Logo Screen

The "cloudy blue sky" Windows 95 logo screen is nothing more than a Microsoft banner, whose purpose is to hide the boot-up process from people who think computers are too complicated. Several publications have provided instructions for turning off this logo screen, thereby allowing the user to view the boot-up process. Viewing this process is important to monitor the status of driver loading, and to interactively gain control of the boot procedure.

To disable this logo screen the following steps are necessary.

- 1) Start a DOS box so you can use EDIT and ATTRIB.
- 2) Change to the root of drive C:
- 3) Reset the file attributes on MSDOS.SYS using the following command:

```
c:> attrib -r -s -h msdos.sys [Enter]
```
- 4) Edit this file:

```
c:> edit msdos.sys [Enter]
```

- 5) In the [Options] section of the file, add a line which contains:

```
Logo = 0
```

- 6) Save the file and exit the EDIT program.
- 7) Change the file attributes back using the following command:

```
c:> attrib +r +s +h msdos.sys [Enter]
```

Now, the boot-up process will scroll on the screen, allowing you to see exactly what is going on.

During the modification of MSDOS.SYS, there are several other items you may need to add for optimum performance. These items should also go in the [Options] section of the file. These options and purpose are:

- 1) BootDelay = 1
- 2) DBLSpace = 0
- 3) DRVSpace = 0

The first line changes the default 2 second delay during the boot-up process to 1 second. This delay allows you to hit [F8] to obtain the “manual boot-up” menu. Setting this to zero makes using [F8] almost impossible. The last two items disable the default loading of these drivers, which usually only consume valuable memory. Note, don’t disable these if you are using DoubleSpace or DriveSpace!

Necessary DOS Programs

Even though much of Windows 95 has been written based on 32 bit code, many 16 bit utilities and drivers still exist. Additionally, many applications require DOS drivers, and many users still find DOS commands necessary, or more convenient than repeatedly clicking the mouse. Therefore, Windows 95 includes DOS Version 7.0.

Previous version of DOS stored the operating system files in a directory named DOS. Windows 95 stores DOS 7 in a directory beneath Windows named *Command*. Unfortunately, this directory is not complete - there are several necessary DOS programs which are not installed by default. These programs (HELP, PRINT, MEMMAKER, MSD, and associated help data files) should be manually loaded from the diskettes or CD-ROM. (Other DOS programs may be desired depending on your particular needs. Review the *Command* directory to determine if other required modules are missing.)

4 Ways to Run DOS

Windows 95 brings users four ways to run DOS, each somewhat different. Method 1 involves using the MSDOS icon from the “Program Menu”. This method causes Windows 95 to start a DOS box. The MSDOS icon allows the user, via the “Property Sheet”, to specify a command or batch file to be run when the DOS box is created. This batch file can be used as a psuedo-autoexec file to configure the DOS box. The Path and any necessary Environment variables can be set here. Setting up “short cuts” to several DOS boxes allows the specification of several psuedo-autoexec files, providing a variety of custom DOS environments. Invoking a DOS box in this manner retains all of the Windows 95 drivers currently running, such as disk caching, the mouse, and the CD-ROM.

Method 2 involves using the “Shut Down” menu and activating the “Restart in MS DOS Mode” option. Unfortunately, this method dumps most of the drivers Windows 95 was using. The resulting DOS environment does not have disk caching or the mouse enabled. However, you can setup a file named DOSSTART.BAT, which contains the necessary configuration directives to regain the usage of these drivers. DOSSTART.BAT should reside in the Windows directory.

Method 3 involves gaining control of the boot-up process through the use of the [F8] key. The timing of striking [F8] is somewhat important, so it helps if you have disabled the Windows 95 logo/graphics screen as discussed above.

Method 4 involves modifying the Windows 95 startup procedure and is discussed in Part II of this article.

Printing from DOS Boxes

Windows programs address printers indirectly through the system via a “device context”. This method relies on device drivers supplied with the printer or Windows. DOS programs on the other hand use output statements that print directly to a port, such as LPT1 or LPT2. While this procedure still works, current networks refer to printers by name instead of a captured port. In order to associate a network printer to a parallel port, the following command should be issued.

```
NET USE LPT3: \\network_name\printer_name
```

This command associates parallel port 3 with the printer "printer_name" on the network "network_name". This command must be issued every time Windows is started, furthermore, this command can not be placed in AUTOEXEC.BAT, since the network must be logged before the NET USE command is issued.

Alternatively, from the "printers" group window, select the desired printer and alter its properties using the "device" tab. This method is cleaner than the command line and retains the setting when restarting the machine.

Problems with Aladdin ESLs and Windows/NT

In August, the master disks for **CAESAR II** Ver 3.23, **PVELite** Ver 2.00, and **CODECALC** Ver 5.50 were re-cut to avoid several Windows/NT problems encountered with the Aladdin ESLs (External Software Locks). These versions were generated using the latest software from Aladdin, which unfortunately caused two problems when run on Windows/NT networks or Windows/NT workstations.

The first problem involved printing through a local white ESL when running from a Windows/NT workstation. The system responded with an illegal instruction and aborted the program.

The second problem involved running the software on any workstation, from a Windows/NT network server where the red network ESL was installed. Any time access to the ESL from a 32 bit module was attempted, the workstation either locked up or rebooted.

The corrected versions/patch of these programs are: **CAESAR II** Ver 3.23c, **PVELite** Ver 2.00a, and **CODECALC** Ver 5.50b. If you have a Windows/NT workstation or network server and need these corrected versions, please contact your COADE Sales representative.

Errata - Modeling Spring Cans with Friction in CAESAR II

In the February, 1996 issue of Mechanical Engineering News, an example for modeling spring cans with friction was provided. However, the method described requires the following corrections:

In the original article the Hanger was placed at Node 15, with a Cnode at 10. This actually caused the spring can to be supported by the pipe, rather than the pipe supported by the spring can. To correct this, simply place the Hanger at Node 10, with a Cnode at 15.

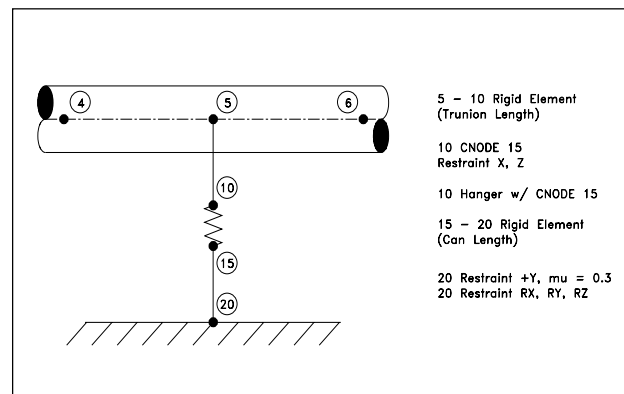
RX and RZ restraints must be added at Node 20. Without these restraints, Node 20 will pivot and absorb all attempted pipe movement without friction. (For consistency, you could also move the RY restraint from Node 10, CNODE 20 down to Node 20.)

The corrected input is as shown below.

```

PIPE DATA
-----
From 4 To 5 DX= 5.000 ft.
PIPE
Dia= 8.625 in. Wall= .322 in. Insul= .000 in.
GENERAL
Mat= (1)LOW CARBON STEEL E= 29,500,000 lb./sq.in. v = .292
Density= .2899 lb./cu.in.
-----
From 5 To 6 DX= 5.000 ft.
-----
From 5 To 10 DY= -.750 ft.
RIGID Weight= .00 lb.
RESTRAINTS
Node 10 X Cnode 15
Node 10 Z Cnode 15
-----
From 15 To 20 DY= -1.000 ft.
RESTRAINTS
Node 20 +Y Mu = .30
Node 20 RX
Node 20 RY
Node 20 RZ

```



CAESAR II Notices

Listed below are those errors & omissions in the **CAESAR II** program that have been identified since the last newsletter.

- 1) Force/Stress Computation Module: An error was discovered in the handling of “directional bi-linear” restraints in the formulation of the restraint load report. Depending on the direction of movement, some “+” direction restraint loads were reported with the wrong sign. This error only affects the displayed value, not the computations.

This error exists in all 3.x versions of the software, up to 3.23 Patch A, which corrected the problem. This patch has been posted on the BBS and WEB sites.

- 2) Equipment Module: An error was discovered in the display of the NEMA23 and API617 allowable for the force summation. The value displayed was passed through a conversion routine twice. This error only affects the displayed value, not the computations.

This error exists only in Version 3.23, and was corrected in 3.23 Patch A.

An error was discovered in the HEI routine when data was directed to the printer - the units conversion routine was not invoked. This error exists in Version 3.22 and 3.23, and was corrected in 3.23 Patch A.

- 3) Piping Error Check Module: An error was discovered in the setup for the Center of Gravity routine when the insulation thickness was set to zero, as opposed to being left blank. This error caused incorrect fluid weights to be reported in the CG and Pipe Properties reports.

This error exists only in Version 3.23, and was corrected in Patch A. Both the CG and Pipe Properties reports are self contained. This error does not affect the analysis in any way!

- 4) Input Listing/Echo Module: A memory allocation error has been found which sometimes prevented the report title lines from printing. This error was corrected in Ver 3.23 Patch A.
- 5) Piping Error Check Module: An error was discovered in the setup of the “cold spring” element force loads for combined jobs using the “read_now=no” setting, AND when the included job also contained concentrated forces or rigid elements. This error only occurs when

using the cold spring materials (18 & 19). Models built using the “thermal expansion” method for cold spring do not have this problem.

This error exists in all 2.x and 3.x versions, and was corrected in 3.23 Patch B. This patch has been posted on the BBS and WEB sites.

- 6) WRC-107 Module: Two errors have been discovered in the 3.23 version of the WRC-107 module. For spherical shells, the computed hoop pressure stress was too high by a factor of 2. Additionally, the Occasional Load Case Allowable Stress Increase Factor was applied to the Sustained case.

This error exists only in Version 3.23 and was corrected in 3.23 Patch B. This patch has been posted on the BBS and WEB sites.

- 8) Element Generator Module: An error was discovered in the generation of the load vector for bend elements if: the number of load types defined (W, T1, P1) plus the number of primary load cases (not algebraic combinations) exceeded 20.

This error exists in Versions 3.19 through 3.23b, and was corrected in 3.23 Patch C.

- 9) All Protected Modules: All modules which access the External Software Lock (ESL) were re-linked to overcome errors which prevented the software from working properly when used in connection with Windows/NT.

These errors only exist in Version 3.23b, and were corrected in 3.23 Patch C.

TANK Notices

Listed below are those errors & omissions in the **TANK** program that have been identified since the last newsletter.

- 1) Input Module: An error has been discovered in the acquisition of the material yield strength for structural roof members - the units conversion constant was not applied. This results in the yield strength being much lower than it should be, causing larger cross sections to be selected, when using non-English units.

This error exists in all 1.30 and 1.31 versions, up to 1.31b, which corrected the problem. The correction was made available in Patch B, on the BBS and WEB sites.

- 2) Solution Module: An error has been discovered in the variable point thickness computation when the fluid does not extend into the upper shell course. The minimum shell thickness was set before the corrosion allowance was added.

This error exists in all versions of **TANK**, up to 1.31c, which corrected the problem. The correction was made available in Patch C, on the BBS and WEB sites.

- 3) Graphics Module: An error was discovered in the display of the Tank Sketch, when there were more than 9 shell courses. Courses 10 and above did not display with their dimensions.

This error exists in all versions of **TANK**, up to 1.31c, which corrected the problem. The correction was made available in Patch C, on the BBS and WEB sites.

- 4) Solution Module: An error has been discovered in the variable point thickness computation for small diameter tanks with corrosion. If the minimum thickness from Table 3.6.1.1 governed, then the corrosion allowance was added into the required thickness twice.

This error exists in all versions of **TANK**, up to Version 1.40 which corrected the problem.

PVELite Notices

Listed below are those errors & omissions in the **PVELite** program that have been identified since the 2.00 release in July. These have all been fixed in Patch A, which has been posted on the BBS and Web Sites.

- 1) Base-ring Error Checker: In the event the user had incomplete or incorrect data the program would abort during the execution.
- 2) Flange Analysis: The program would abort when running from windows when a flange design was performed. This error did not occur in DOS.
- 3) Nozzle Design: The required thickness of the nozzle neck T_{rn} was computed based on the I_d formula only, regardless of the option chosen by the user.
- 4) ASCE 95 Wind: If the vessel was on a hill (3d or 2d), the value of K_{zt} should have been computed at each intermediate elevation and was not.

CodeCalc Notices

Listed below are those errors & omissions in the **CODECALC** program that have been identified since the last newsletter.

- 1) WRC107: If the load input was specified in global coordinates, the direction vectors in the input echo were reversed. If the geometry included a pad, a warning message regarding the pad/vessel diameter ratio 0.571 was incorrectly printed.

This error exists only in Version 5.50. It is fixed in Patch A, which has been posted on the BBS and WEB Sites.

- 2) Flange: For TEMA channel covers, the corrosion allowance was not considered in the deflection calculations.

This error exists in versions up to 5.50. It is fixed in Patch A.

- 3) ASMETUBE: For fixed tubesheets, the required tubesheet thickness is now iterated differently to ensure convergence. Also if tubesheet is gasketed on both sides, the tubesheet OD should equal the flange face OD.

The iteration improvement was reflected in Patch A. The error exists in versions up to 5.50a. It was fixed in Patch C, which has been posted on the BBS and WEB Sites.

- 4) Windows NT related Printing Problem: These were fixed in Version 5.50 Patch B. If you experience printing related problems on Windows NT, please contact COADE.

- 5) Nozzle: The printout for UG-45 minimum nozzle neck thickness comparisons have been expanded especially if Case 3 (MAPnc) governs.

This is reflected in Patch C.

- 6) Lgcenter: For Large Openings per ASME VIII Div. 1 App. 14, the printout reflected the allowable stress at ambient temperature. It should have printed out the stress at design temperature.

This error exists in versions up to 5.50b. This is fixed in Patch C.

Why Running the Latest Software is Important

Technical Changes: COADE software programs perform computations to address the requirements of Government and Industry Society Codes. These Codes change frequently, at least once a year. Utilizing the latest versions of COADE software programs insures that your calculations comply with the recent changes and additions made to the Codes.

Environment Changes: The User's operating environment is constantly changing - faster, more powerful computers are always available. Operating systems change every twelve to eighteen months. Corporations are regularly changing and upgrading network systems. These constant changes mean that application software must also adjust to this shifting environment. Utilizing the latest versions of COADE software programs insures that the software will continue to run in your environment, trouble free.

Corrections: Many people are surprised that commercial software contains errors, otherwise known as bugs. It is a known fact that *all software contains errors*, no matter how well tested. Software vendors who refuse to acknowledge errors are being less than honest. It is COADE's policy to correct software errors as soon as possible and make them available to users via the Internet or our BBS. Utilizing the latest versions of COADE software programs insures that all reported errors from previous versions are corrected, and that any newly discovered errors can be patched from the Internet or BBS. (Patches only apply to the latest version of the software, out-of-date versions cannot be corrected.)

Capabilities: In addition to technical changes, COADE constantly makes changes to the software to provide more capabilities. These changes include such items as: file managers, internal accounting, configuration options, interfaces to other software packages, etc. Many changes are the direct result of user suggestions. Utilizing the latest versions of COADE software programs provides the latest capabilities.

Support: COADE offers close to instantaneous telephone support, from an Engineering Software Developer. There are no automated voice mail boxes or answering machines. Support is also available via the fax or e-mail. Utilizing the latest versions of COADE software programs insures that your support issues can be addressed in an efficient manner.

COADE Engineering Software

(Note: Area Codes will change from 713 to 281 effective November 2, 1996)

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